

Carbon Pricing, Climate Policy Mixes, and Clean Innovation Outcomes

A presentation to the

**Economics and Environmental Policy Research
Network Research Symposium**

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What is innovation?

- Innovation involves *change* and *novelty*
- Innovation involves people and organisations:
 - Discovering new things (e.g. turning non-resources into resources)
 - Doing things differently
- Innovation may relate to:
 - Technology: products, processes
 - Services
 - Institutions (e.g. property rights, law, policy)
 - Organisations (e.g. management processes)
 - Lifestyles, culture

Why do people innovate?

- Curiosity
- Increase in productivity, income, wealth
- Economic innovation often involves cost, investment risk
- Importance of incentives

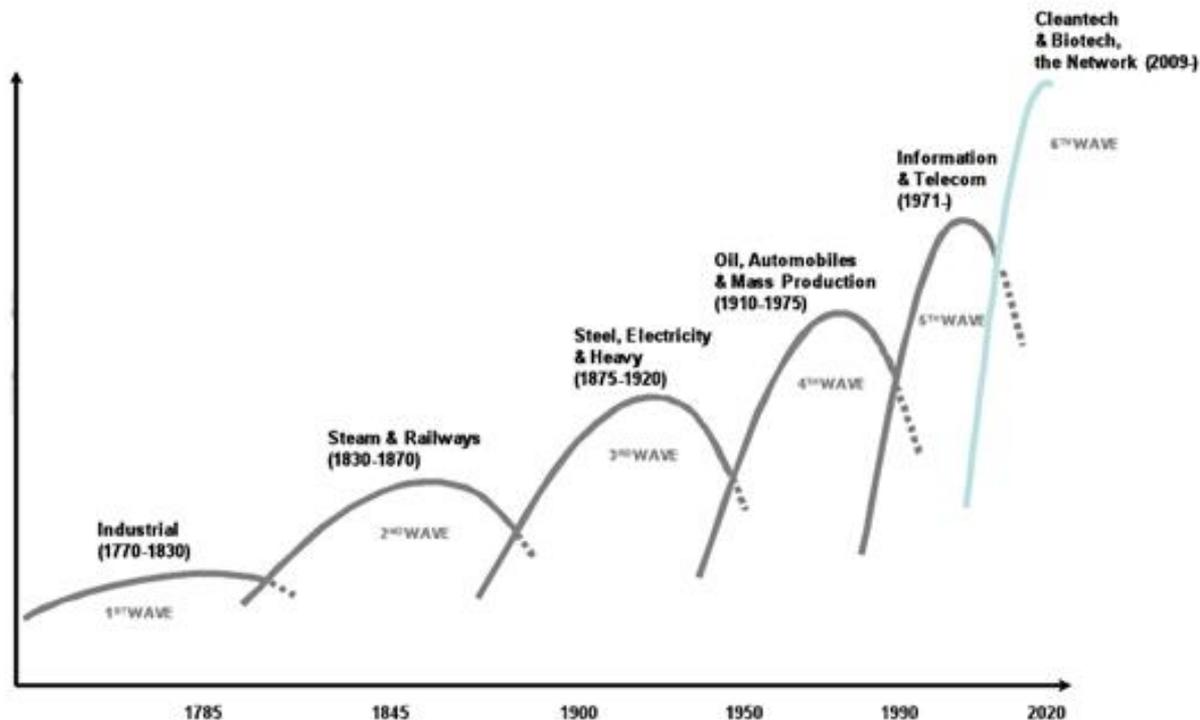
What kind of innovation?

- No shortage of innovation in general
- Here interested in *directed* innovation for:
 - Low-carbon technologies, practices
 - Resource efficiency
 - Reduced environmental impacts

Waves of industrial innovation

Reproduced from Zenghelis 2011 Networked Solutions for 21st-Century Challenges: The Economics of Complexity and Scarcity, and the Role of Networked Innovation, https://www.cisco.com/c/dam/en_us/about/ac79/docs/ps/Global-Challenges-and-Network-Technologies.pdf

Figure 1. Waves of Industrial Innovation.



Source: Raising Consumption, Maintaining Growth, and Reducing Emissions: The Objectives and Challenges of China's Radical Change in Strategy and Its Implications for the World Economy," Nicholas Stern, World Economics, Vol. 2, No. 4, October–December, 2011; DONG Energy. 2009. Diagram is based on Perez (2002) drawing on report by Merrill Lynch, 2008.

What are the barriers to clean innovation?

Why do markets by themselves not generate enough of it?

- Difficulty of private capture of benefits (all innovation)
 - Positive externality; public policy, subsidy
- Environmental costs fall on those not responsible for them:
 - Negative externalities, public policy, taxes
- Infrastructure, lock-in
- Bounded rationality, habits, norms:
 - Lifestyle, cultural lock-in

How can carbon pricing help?

- Increased incentives for low-carbon innovation:
 - Taxes: set the price, emissions quantity depends on the ease of emission reduction (elasticity)
 - Trading: sets the quantity, price depends on the level and ease of emission reduction
- What to do with the revenues?
 - Reduce other taxes; Eco-bonus; Energy efficiency (in low-income households); Subsidise low-carbon technologies
- Price level depends on objective:
 - Optimality (Pigouvian); Standards and pricing
 - Stimulation of investment (key for innovation)

Has the EU Emissions Trading System been a success?

Source: Helm Review on the Cost of Energy, 2017,

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/654902/Cost_of_Energy_Review.pdf

FIGURE 40: EU ETS ALLOWANCE PRICES: MONTHLY AVERAGE FRONT YEAR EUA FUTURES PRICE (€/TCO₂)

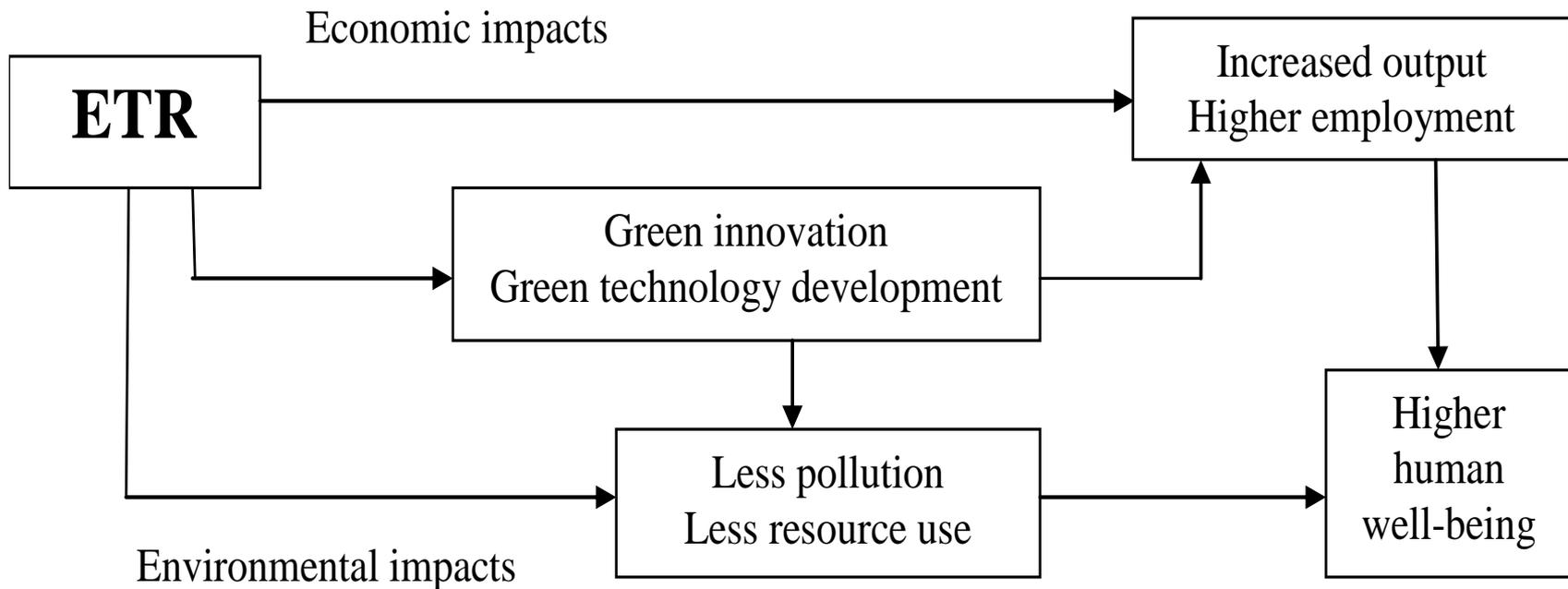


Source: Intercontinental Exchange (ICE).

Notes: Phase 1 EUAs tended to zero at the end of the phase as EUAs issued under it were non-transferable to later phases.

The potential of ETR/GFR:

ETR/GFR is the shifting of taxation from 'goods' (like income, profits) to 'bads' (like resource use and pollution)



Relevant projects on environmental tax reform (ETR) or green fiscal reform (GFR)

- COMETR: Competitiveness effects of environmental tax reforms, 2007. <http://www2.dmu.dk/cometr/>
See Andersen, M.S. & Ekins, P. (Eds.) *Carbon Taxation: Lessons from Europe*, Oxford University Press, Oxford/New York, 2009
- petrE: 'Resource productivity, environmental tax reform (ETR) and sustainable growth in Europe'. One of four final projects of the Anglo-German Foundation under the collective title 'Creating Sustainable Growth in Europe'. Final report published October/November 2009, London/Berlin. www.petre.org.uk
See Ekins, P. & Speck S. Eds. 2011 *Environmental Tax Reform: A Policy for Green Growth*, Oxford University Press, Oxford
- UK Green Fiscal Commission. Final report published October 2009, London. www.greenfiscalcommission.org.uk

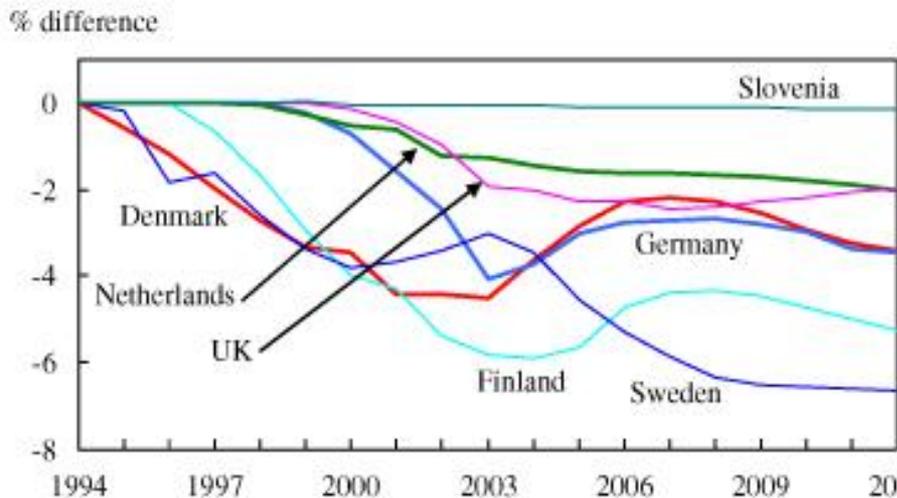
What is the experience to date of ETR in Europe?

- Six EU countries have implemented ETRs: Denmark, Finland, Germany, Netherlands, Sweden, UK
- The outcomes – environmental and economic – have been broadly positive: energy demand and emissions are reduced; employment is increased; effects on GDP are very small
- Effects on industrial competitiveness have been minimal
- See Andersen, M.S. & Ekins, P. (Eds.) *Carbon Taxation: Lessons from Europe*, Oxford University Press, Oxford/New York, 2009

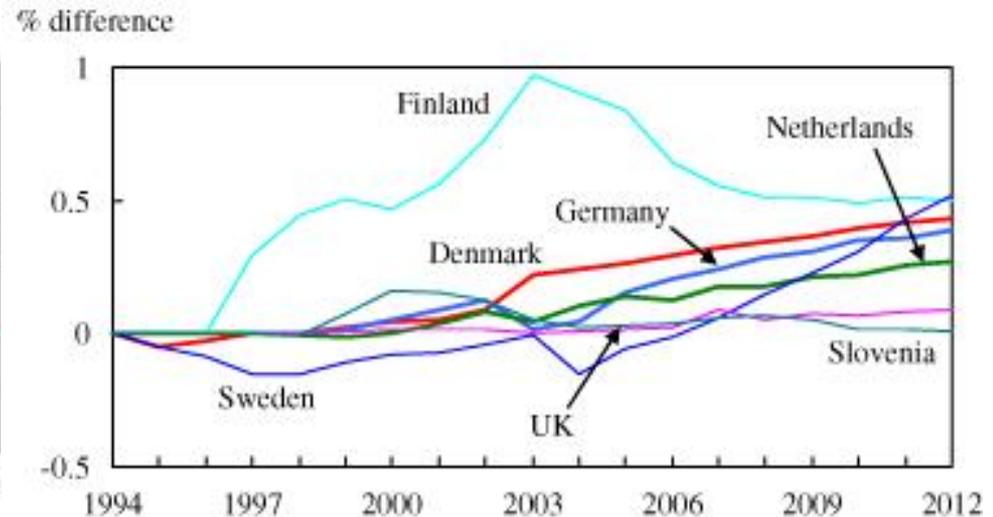
Environmental and economic impacts of ETR, from COMETR study, 2007

CHART 2: THE EFFECT OF ETR ON GHG EMISSIONS

CHART 3: THE EFFECT OF ETR ON GDP

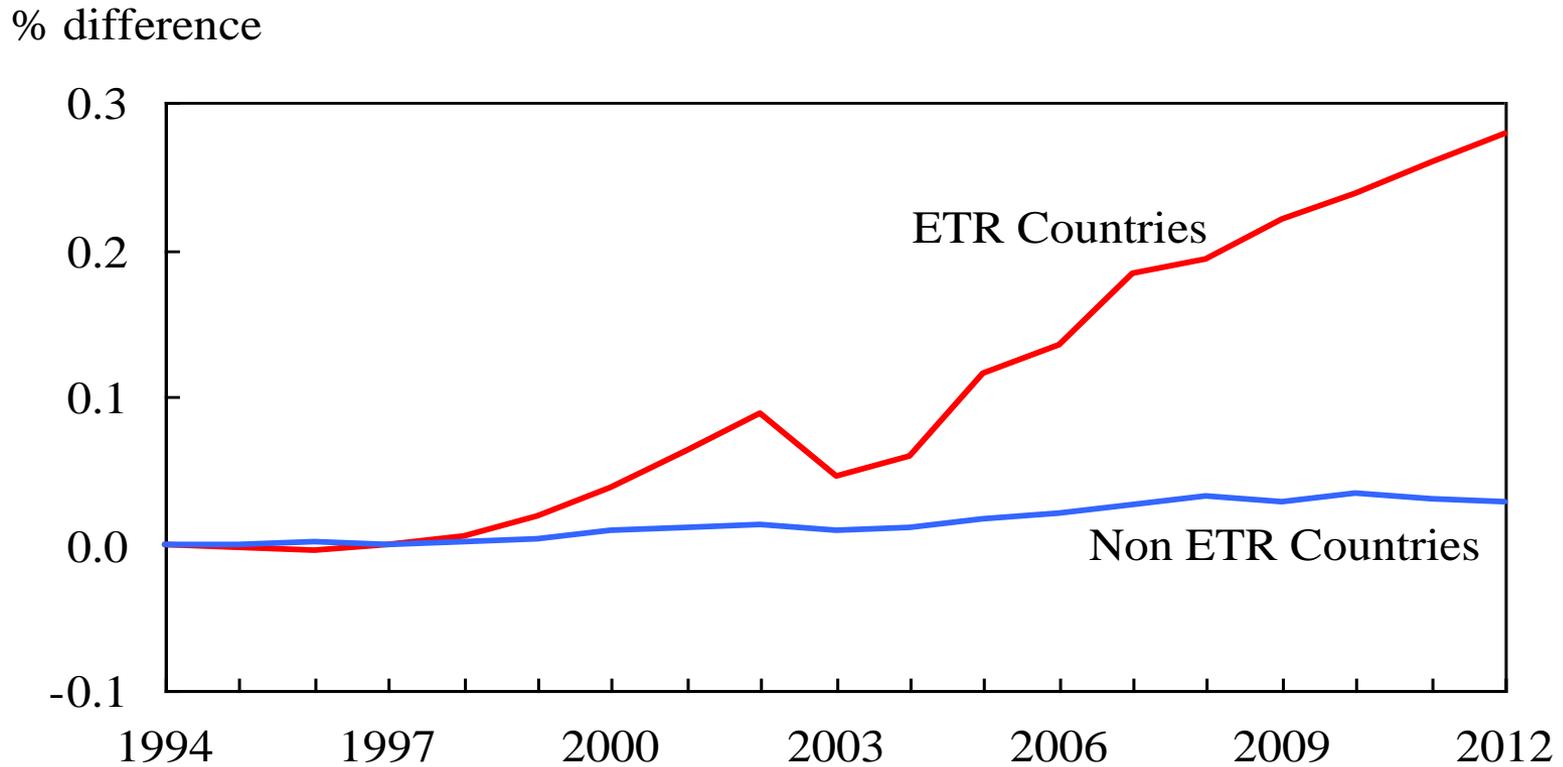


Note(s) : % difference is the difference between the base case and the counterfactual reference case.
 Source(s) : CE.



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 Source(s) : CE.

CHART 7.28: THE EFFECTS OF ETR: GDP IN ETR AND NON ETR COUNTRIES



Note(s) : % difference is the difference between the base case and the counterfactual reference case.

Source(s) : CE.

So, carbon price is it then?

“The prescription .. is simple: price carbon ... and get out of the way. It’s simple. It works.”

*- Gernot Wagner, Harvard University and
Environmental Defense Fund*

Wrong!

Solar revolution – Fruit of the Energiewende



“Solar power is by far the most expensive way of reducing carbon emissions
- *The Economist*, 2014.

‘[deploying current renewables] is not only blinkered, but also incredibly expensive’
— Dieter Helm

Solar power in Germany
“makes as much sense as growing pineapples in Alaska.”
- J. Grossmann, then CEO of RWE AG in 2012

PV: New record installed power prices
Chile = \$30/MWh
Masdar = \$25/MWh
Abu Dhabi = \$24/MWh

Module costs: -29% in 2016 to \$0.39/Watt

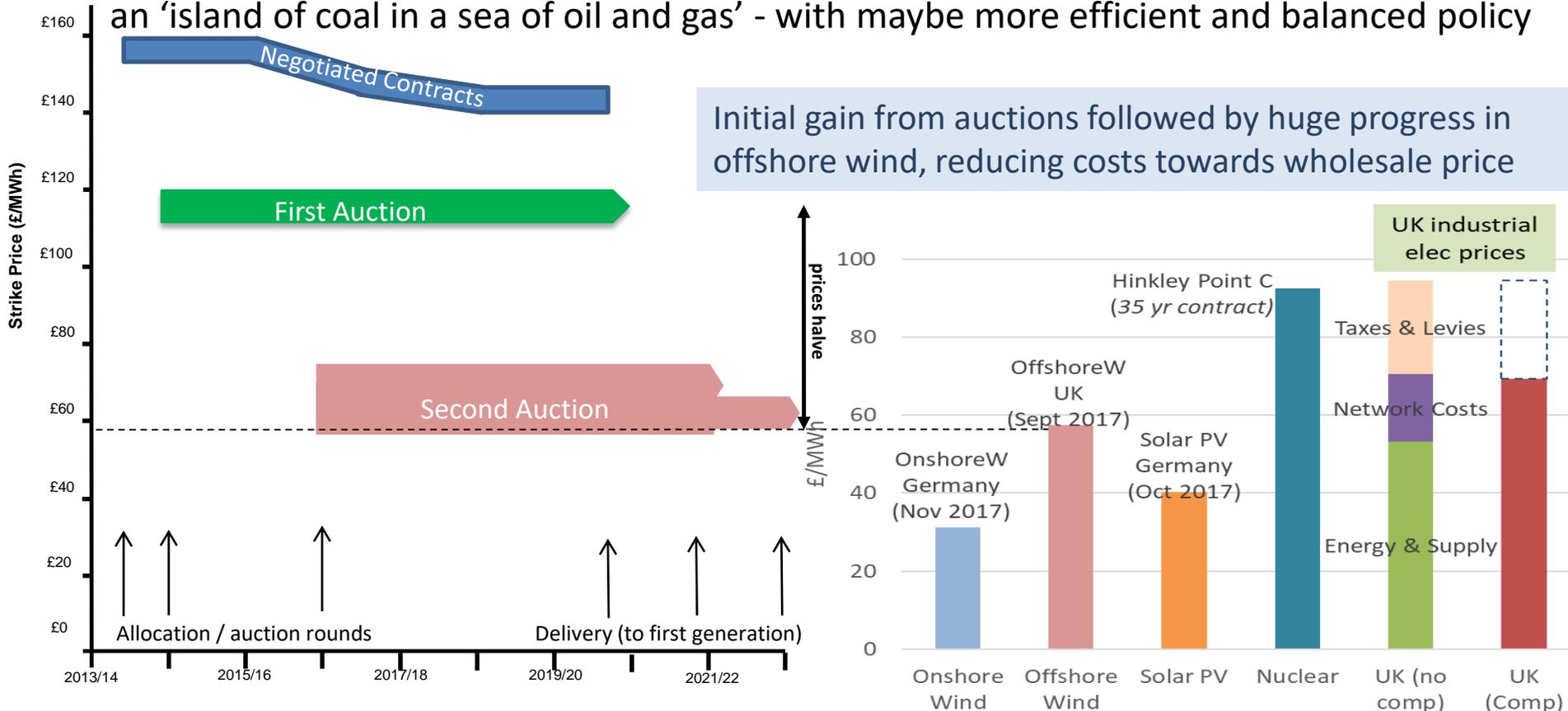


<http://www.bloomberg.com/features/2016-ev-oil-crisis/>
<http://www.bloomberg.com/news/articles/2016-07-27/elon-musk-says-it-s-pencils-down-for-tesla-s-model-3>

<http://reneweconomy.com.au/how-the-jaw-dropping-fall-in-solar-prices-will-change-energy-markets-55160/>

With benefits and lessons for UK Offshore wind

That the UK has been able to draw on to engineer our own dramatic transformation for an 'island of coal in a sea of oil and gas' - with maybe more efficient and balanced policy



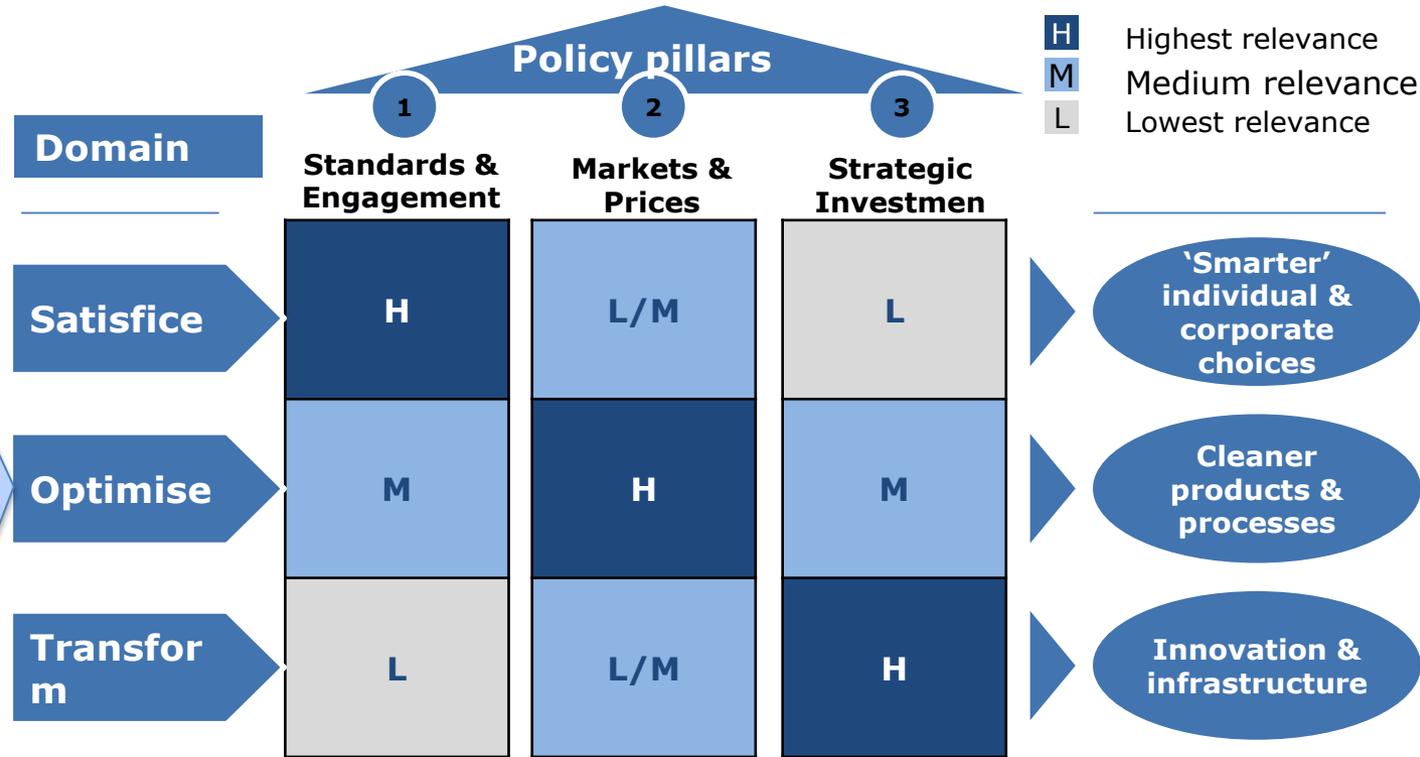
Sources: M.Grubb and D.Newbery (2018), 'UK Electricity Market Reform and the Energy Transition: Emerging Lessons', MIT-CEEPR working paper; Grubb & Drummond (2018), UK Industrial Elec Prices

Ideal policy comprises a package

Key is to match the best instrument to the respective domain of decision-making

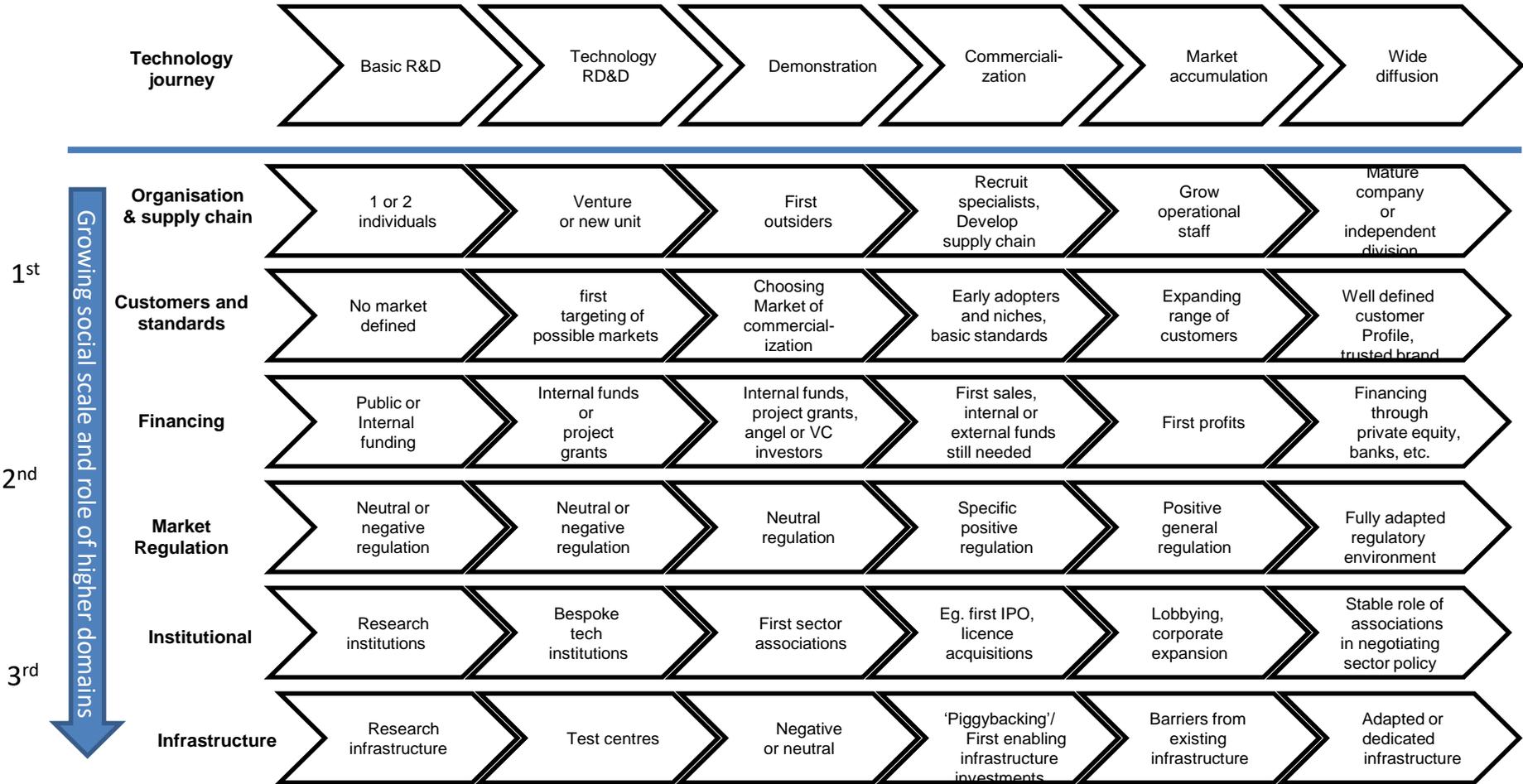
“Other policies such as feed-in tariffs, industry regulation and subsidies, are far less economically preferable than carbon pricing to reduce emissions... “ (OECD, 2013)

“The EU 3-targets approach is madness.. “



Policies for three domains of decision-making

Successful innovation must span a complex multi-domain journey



Source: Grubb, McDowell and Drummond (2017), On order and complexity in innovations systems, Energy Research & Social Science; derived from Fig.9.8 in Grubb et al (2014) Planetary Economics

Importance of a policy mix

Miedzinski, M. 2017 'What are specific characteristics and design features of policy mixes supporting clean innovation?', mimeo, UCL

- Combinations of innovation and environmental policy instruments is more effective in supporting clean innovation than any single policy instrument
- Policy mixes supporting clean innovation need to balance support for technology variety and deployment of mature clean technologies
- Long-term vision and targets are key elements of policy mix supporting clean innovation
- Policy mix for clean innovation needs to be reflect the maturity of technology
- Policy mix for clean innovation needs to be adapted to the needs and capacities of actors in the targeted sectors, regions and innovation value chain
- Designing effective policy mixes for clean innovation requires system evaluation and policy learning capacity

Technology hierarchy levels and relevant deployment mechanisms

Source: Schmidt, Tobias S., et al. (2016), 'Do deployment policies pick technologies by (not) picking applications?—A simulation of investment decisions in technologies with multiple applications', *Research Policy*, 45 (10), 1965-83, cited in Miedzinski, M. 2017 'What are specific characteristics and design features of policy mixes supporting clean innovation?', mimeo, UCL

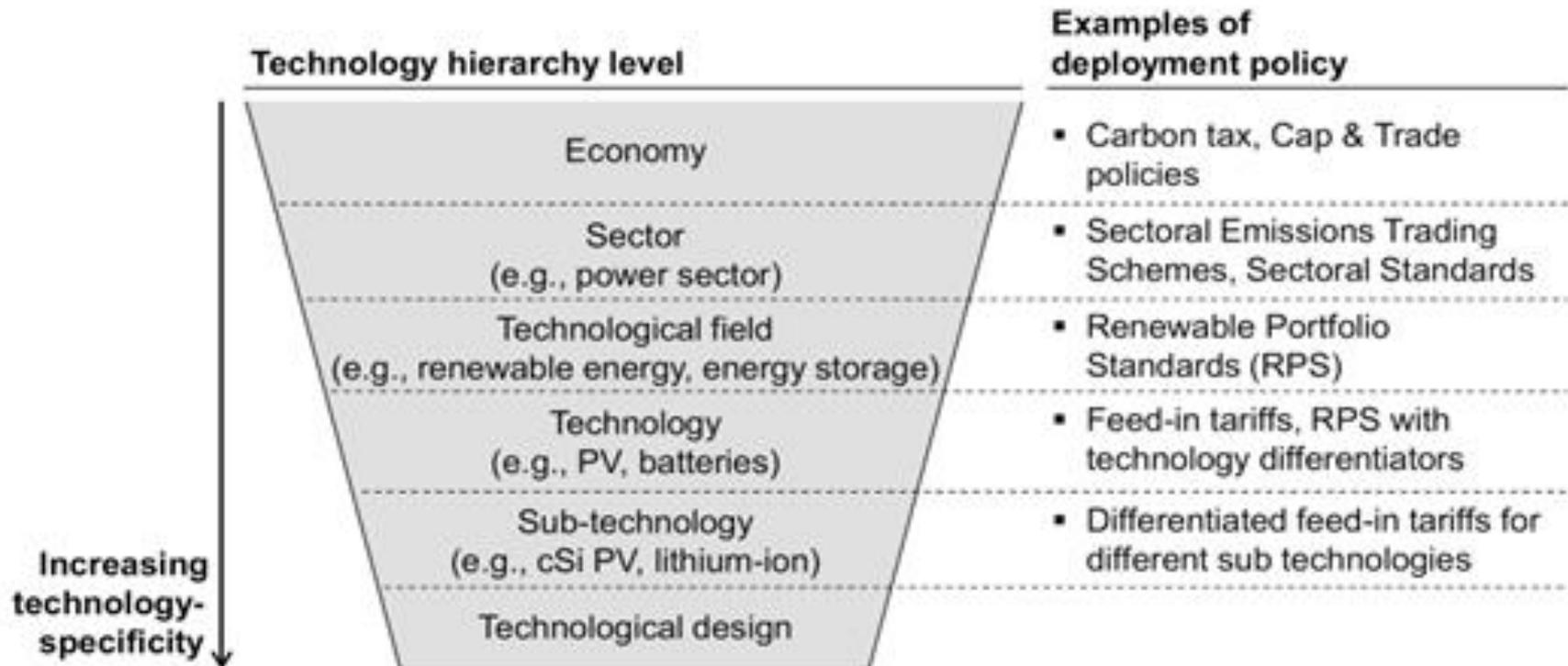


Fig. 2. Technology-specificity, technology hierarchy levels and examples of deployment policies – adapted from [Winskel et al. \(2013\)](#)

Importance of institutional innovation

Rodrik D. and Rigobon R. (2004), “Rule of Law, Democracy, Openness, and Income: Estimating the Interrelationships,” NBER Working Papers 10750, cited in Zenghelis, D. 2011 ‘ The Economics of Network-Powered Growth’, <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.642.9915&rep=rep1&type=pdf>

- Five institutions important for growth and innovation—those that:
 - protect property rights,
 - provide regulatory oversight,
 - promote more economic stability, and
 - provide social insurance and conflict management.

Policy for climate change and innovation

Aghion, P., Hepburn, C., Teytelboym, A. and Zenghelis, D. 2014 'Path dependence, innovation and the economics of climate change', Centre for Climate Change Economics and Policy, LSE, London

- **A suitable policy to fight climate change should combine a carbon tax (or cap-and-trade scheme) with direct support for research, deployment and adoption of low-carbon innovation.**
- **Both governments and private sector can play important roles:** private market forces need to be mobilised and redirected towards cleaner energy sources by governments, but clearly governments cannot substitute for the market.
- Government intervention would be **credible, transparent, and non-discriminatory**, avoiding pork-barrel politics and industry capture.
- **Governments must act now:** delaying policies that would redirect innovation towards clean energy sectors and activities will result in much higher costs in the future.
- More developed countries should act as **technological leaders** in implementing new environmental policies, and they should subsidise the access to new clean technologies by less developed countries.
- They should consider the possibility of using **border carbon adjustments** against any country that would take advantage of the new environmental policies to specialise in the production and export of fossil fuel intensive products.



Thank you

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www.bartlett.ucl.ac.uk/sustainable